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INDIVIDUAL DIFFERENCES IN JUDGMENTAL PROCESSES: CONFIDENCE IN HUMAN KNOWLEDGE, PERCEPTION, AND DECISION-MAKING: SUMMARY OF PROCEDURES AND PRELIMINARY FINDINGS

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Abstract

This report outlines the methodology and presents selected findings from a study that was designed to investigate how individual difference variables in decision-making influence judgment processes. Specifically, we assessed the extent to which three individual difference variables (Personal Need for Structure, Personal Fear of Invalidity, Need for Cognition) influenced speed, accuracy, and confidence in a number of decision-making tasks under varying degrees of uncertainty. One hundred and four participants (30 men and 74 women) were recruited from the University of Lethbridge. The participants completed a battery of questionnaires including the individual difference variables under consideration. Students were contacted and were invited to participate in two experimental sessions: In one session, they completed a series of computer-administered decision tasks (e.g., line length estimation, vocabulary, and trivia knowledge). In another session, the participants completed a military threat assessment task called TITANS (Team and Individual Tactical Assessment Networked Simulator), a medium fidelity computer-based naval surveillance and threat assessment task. Preliminary results reveal associations between the individual difference variables and speed, confidence, and accuracy in decision-making. Future directions for research with respect to the interaction of individual differences in decision making and restriction of cognitive capacity (e.g., due to fatigue and/or time pressure) are discussed.

Résumé

Le présent rapport décrit la méthodologie et expose certaines des constatations d'une étude conçue pour examiner la façon dont les différences individuelles dans la prise de décision influent sur les processus de jugement. Plus particulièrement, nous avons évalué dans quel mesure trois variables de différences individuelles (besoin personnel de structure, crainte personnelle d'incapacité et besoin de cognition) agissaient sur la vitesse, l'exactitude et la confiance dans l'accomplissement d'un certain nombre de tâches décisionnelles, à divers degrés d'incertitude. Au total, 104 participants (30 hommes et 74 femmes) ont été recrutés à l'Université de Lethbridge. Les participants ont rempli un éventail de questionnaires portant notamment sur les variables de différences individuelles susmentionnées. Les étudiants ont été invités à participer à deux séances expérimentales. Au cours de l'une des séances, ils ont accompli une série de tâches décisionnelles à l'ordinateur (estimation de longueur de ligne, vocabulaire et connaissances générales). Dans le cadre de l'autre séance, les participants ont effectué une évaluation de menace militaire intitulée TITAN (Réseau d'évaluation des menaces pour l'individu ou le groupe). Il s'agit d'une simulation informatisée de surveillance navale et d'évaluation des menaces, qui est de fidélité moyenne. Les résultats préliminaires ont révélé des corrélations entre les variables de différences individuelles et la vitesse, la confiance et l'exactitude dans la prise de décision. On y discute aussi l'orientation future des recherches concernant l'interaction de différences individuelles dans la prise de décision et la restriction de la capacité cognitive (fatigue et/ou contrainte de temps).

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Executive summary

This report outlines the methodology and presents preliminary findings from a study that was designed to investigate how individual difference variables in decision-making influence judgment processes. By way of background, this research study that forms the basis of the work outlined here was designed to assess the extent to which three individual difference variables (Personal Need for Structure, Personal Fear of Invalidity, Need for Cognition) influenced speed, accuracy, and confidence in a number of decision-making tasks under varying degrees of uncertainty. Note that the statement of work associated with this contract involved conducting mass testing sessions, subject recruitment, the conducting of the individual difference study, as well as very preliminary data collation at an off-institute site (the University of Lethbridge). Thus, the rest of the report will specify methodological and procedural details, as well as describe the sample that participated in the study.

One hundred and four participants (30 men and 74 women) were recruited from the University of Lethbridge. The participants completed a battery of questionnaires including the individual difference variables under consideration. Students were contacted and were invited to participate in two experimental sessions: In one session, they completed a series of computer-administered decision tasks (e.g., line length estimation, vocabulary, and trivia knowledge). In another session, the participants completed a military threat assessment task called TITANS (Team and Individual Tactical Assessment Networked Simulator), a medium fidelity computer-based naval surveillance and threat assessment task. Preliminary results reveal associations between the individual difference variables and speed, confidence, and accuracy in decision-making. Future directions for research with respect to the interaction of individual differences in decision making and restriction of cognitive capacity (e.g., due to fatigue and/or time pressure) are discussed.

Sommaire

Le présent rapport décrit la méthodologie et expose certaines des constatations d'une étude conçue pour examiner la façon dont les différences individuelles dans la prise de décision influent sur les processus de jugement. À titre de contexte, cette étude de recherche, qui jette la base du travail présenté ici, a été conçue pour évaluer dans quel mesure trois variables de différences individuelles (besoin personnel de structure, crainte personnelle d'incapacité et besoin de cognition) agissaient sur la vitesse, l'exactitude et la confiance dans l'accomplissement d'un certain nombre de tâches décisionnelles, à divers degrés d'incertitude. Prière de noter que l'énoncé de travail joint à ce contrat prévoyait la direction de séances de tests pour des groupes nombreux, le recrutement de sujets, la réalisation d'une étude sur les différences individuelles ainsi que la collecte de données très préliminaires dans un établissement de l'extérieur (Université de Lethbridge). Par conséquent, le reste du rapport donnera des détails sur la méthodologie et la procédure et décrira le groupe-échantillon qui a participé à l'étude.
Au total, 104 participants (30 hommes et 74 femmes) ont été recrutés à l'Université de Lethbridge. Les participants ont rempli un éventail de questionnaires portant notamment sur les variables de différences individuelles susmentionnées. Les étudiants ont été invités à participer à deux séances expérimentales. Au cours de l'une des séances, ils ont accompli une série de tâches décisionnelles à l'ordinateur (estimation de longueur de ligne, vocabulaire et connaissances générales). Dans le cadre de l'autre séance, les participants ont effectué une évaluation de menace militaire intitulée TITAN (Réseau d'évaluation des menaces pour l'individu ou le groupe). Il s'agit d'une simulation informatisée de surveillance navale et d'évaluation des menaces, qui est de fidélité moyenne. Les résultats préliminaires ont révélé des corrélations entre les variables de différences individuelles et la vitesse, la confiance et l'exactitude dans la prise de décision. On y discute aussi l'orientation future des recherches concernant l'interaction de différences individuelles dans la prise de décision et la restriction de la capacité cognitive (fatigue et/ou contrainte de temps).

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Individual Differences in Judgmental Processes:

Confidence in Human Knowledge, Perception, and Decision-Making

Introduction

Military personnel make decisions varying in uncertainty during the course of their daily activities. Although such situations are integral to particular military duties, to date little attention has been devoted to understanding the factors that affect military decision-making. It is important to note that at times, military personnel are called upon to make important decisions that are based on ambiguous and sometimes even conflicting information. Thus, a greater understanding of factors that affect decision-making under constraints such as uncertainty holds both theoretical and practical importance.

A primary area of the decision-making research for the Command Group is the influence of individual differences upon judgment processes. Although cognitive psychology has long documented the existence of individual differences in judgments, to date virtually no research has attempted to understand the basis for these differences. The research project that formed the basis of the work reported here was designed to begin to delineate specific individual difference variables that influence judgmental processes. Of particular interest was the role of cognitive styles, defined as consistent modes of information gathering demonstrated to affect the knowledge-seeking/judgmental process in important ways. Three cognitive styles, Personal Need for Structure (PNS; Thompson, Naccarato, & Parker, 1989; in press), Personal Fear of Invalidity (PFI; Thompson et al., 1989; in press) and Need for Cognition (NFC; Cacioppo & Petty, 1982; Cacioppo, Petty, & Kao, 1984) were the focus of this investigation.

The statement of work associated with this contract involved conducting mass testing sessions, subject recruitment, the conducting of the individual difference study, as well as very preliminary data collation at an off-institute site (the University of Lethbridge). Thus,

the rest of the report will specify methodological and procedural details, as well as describe the sample that participated in the study. More detailed analyses of the data derived from the judgment tasks is currently underway, but is not reported here as it did not represent a deliverable in the statement of work.

Method

Sample

419 students (267 women, 152 men; mean age = 20.15, SD = 4.42) completed the initial administration of scales. Of these students, 104 people (74 women and 30 men) were invited to participate in the judgment and decision making sessions of the experimental portion of the study.

Participant Recruitment. As part of a mass prescreening questionnaire administered at the beginning of term, introductory psychology students at the University of Lethbridge completed a number of scales pertaining to decision-making, including the Personal Need for Structure scale (PNS; Thompson, Naccarato, & Parker, 1989; in press), the Need for Cognition scale (NFC; Cacioppo & Petty, 1982; Cacioppo, Petty, & Kao, 1984), and the Personal Fear of Invalidity scale (PFI; Thompson et al., 1989; in press). In addition, the students completed the Big Five Factors of Personality Scale (Big 5; McCrae & Costa, 1989) and the Actively Open Minded Thinking Scale (AOT; Stanovich & West, 1998).
Overall, 419 students (267 women, 152 men; mean age = 20.15, SD = 4.42) completed these scales. Of these students, 104 people (74 women and 30 men) were selected to participate in the study.

Procedure

Subsequent to the mass testing session, all participants were contacted by the experimenter by telephone. The experiment and its major procedures were briefly explained to the participants and they were invited to take part at their earliest convenience. They were

informed that participation would entail two sessions: One session would take 2 hours to complete, and they would receive course credit and $20.00 for their participation, whereas the other session would take 1 hour to complete and they would receive course credit and $10.00 for their participation. The order of sessions was counterbalanced, such that students were randomly assigned to the 2 hour/1 hour session condition, or the 1 hour/ 2 hour session condition.

Judgment Tasks

Two Hour Session: Computer-Administered Decision Tasks

In the two-hour session, participants completed three computer-administered decision tasks, outlined below, that were designed to assess speed, accuracy, and confidence in decision making under varying degrees of difficulty. The order of presentation of these three tasks was counterbalanced.

(a) Perceptual Comparison Task.

On each trial of the perceptual comparison task, participants were be required to determine the "LONGER" or "SHORTER" of two horizontal line lengths presented on the video monitor. Participants indicated their response by depressing the left or right button on the mouse. Immediately following the response, participants were presented with a choice of 6 confidence levels (50%, 60%, 70%, 80%, 90%, and 100%), and were told that 50% represented a guess and 100% indicated absolute certainty. One hundred and twenty trials were presented. The difficulty of the decisions was manipulated by varying the ratio of the longer to the shorter line.

(b) Vocabulary Task.

Each trial on the vocabulary task began with the presentation of a target word (e.g., acute) and two alternatives (e.g., sharp, blatant). Participants were instructed to select the alternative that provided the closest match to the target word. Immediately following the response, participants were presented with a choice of 6 confidence levels (50%, 60%, 70%,

80%, 90%, and 100%), and were told that 50% represented a guess and 100% indicated absolute certainty. One hundred and twenty trials were presented. The difficulty of the trials was indexed by the common language word frequencies of the target words, selected from standardized norms.

(c) General Knowledge Task.

Participants were asked to respond to one hundred and twenty questions assessing general knowledge. Questions represented four general content domains: geography, history, arts and literature, and science and nature. Each trial on the general knowledge task began with the presentation of a question (e.g., "On which body of water is Bombay located?" and two response alternatives (e.g., "The Indian Ocean" and "The Arabian Sea"). Participants were instructed to select the alternative that provided the best answer for the question. Immediately following the response, participants were presented with a choice of 6 confidence levels (50%, 60%, 70%, 80%, 90%, and 100%), and were told that 50% represented a guess and 100% indicated absolute certainty.

One hour session: TITANS

TITANS (Team and Individual Tactical Assessment Networked Simulator) is a medium fidelity computer-based naval surveillance and threat assessment task. Participants were presented with a radar display of approximately 32 n.m. range around their own ship. Within this radius were displayed several targets of unknown threat to their own ship. The participant's task was to use a variety of information about each target displayed via computer menus to determine the degree of threat each target represented to the safety of their own ship. Target designations based upon radar information available to participants included: (i) Type of Target: Air, Surface, or Subsurface; (ii) Class of Target: Military, Unknown, or Civilian; and (iii) Intent of Target: Hostile, Unknown, or Peaceful. A military scenario presented to participants at the outset of the study linked each piece of target designation information with a threat likelihood. For instance, a target type of "air" was

considered to represent more of a threat than a target type of "subsurface". Similarly a target class of military was more likely to be hostile than a target class of civilian, etc. Information concerning the type, class and intent of each target was be varied across target designations. In some instances all information consistently indicated that a target was either hostile or peaceful. In other instances some information indicated a non-threatening target and other information concerning the same target indicated that it was hostile (e.g., 'air' and 'civilian'). All participants were instructed to process and assess all target information individually and report their probability estimate of the threat for that target and a confidence estimate for each answer. In order to examine the effects of presentation order effects on belief updating all evidence concerning each target was presented in a serial fashion. Similarly, participants were asked for the probability that the target was hostile vs. friendly, and for their confidence estimate after each piece of target information was given.

For the TITANS task, participants were randomly assigned to a feedback condition or a no-feedback condition. In the feedback condition, participants were provided with a graphic display of their accuracy following each probability estimate, whereas in the no-feedback condition, no such visual display of accuracy was made available to participants.

Summary of Data Analyses

For each decision-making measure, a number of judgment indices were collected.

(a) Response Speed. The response latency between the onset of the stimuli and the participants' response to the stimuli was assessed and recorded for each trial.

(b) Confidence Speed. The amount of time that participants took to provide a rating of their subjective confidence level was recorded for each trial.

(c) Accuracy. Participants' responses to the stimuli were recorded, and a correct/incorrect response was computed for each trial.

(d) Mean confidence rating. Participants' ratings of subjective confidence of the accuracy of their responses were aggregated and recorded.

(e) Overconfidence and Under confidence. Participants' mean accuracy level was compared with their mean confidence level to form an index of overconfidence or under confidence.

(f) Resolution. Participants' accuracy and subjective confidence ratings were compared to provide an index to determine whether their subjective confidence intervals distinguished correct from incorrect responses (i.e., did participants provide lower confidence estimates when their responses were incorrect, and higher confidence estimates when their responses were correct?)

(f) Calibration. An index of the deviation between proportion correct associated with each confidence interval was computed.

The measures of accuracy and confidence were correlated with participants' scores on the individual difference variables assessed during the prescreening session that was administered at the beginning of the academic term.

Preliminary Results

(I) Reliability of Measures

The reliability of the measures was assessed using the entire prescreening data set ($n = 419$). It is important to note that not all of the participants completed every item on every scale, therefore, the number of respondents associated with each scale varies somewhat across the different measures. The reliabilities associated with the scales included are as follows:

(i) Need for Cognition (Cacioppo & Petty, 1982; Cacioppo, Petty, & Kao, 1984):

Cronbach's $\alpha = .86$, based on 413 respondents.

(ii) Personal Need for Structure (Thompson, Naccarato, & Parker, 1989; in press):

Cronbach's $\alpha = .74$, based on 416 respondents.

(iii) Personal Fear of Invalidity (all items, Thompson, Naccarato, & Parker, 1989;

in press): Cronbach's $\alpha = .69$, based on 383 respondents.

(iv) Big Five Factors of Personality Scale (McCrae & Costa, 1989):

Extroversion subscale: Cronbach's $\alpha = .88$, based on 416 respondents

Agreeableness subscale: Cronbach's $\alpha = .70$, based on 418 respondents

Conscientiousness subscale: Cronbach's $\alpha = .79$, based on 416 respondents

Neuroticism subscale: Cronbach's $\alpha = .82$, based on 418 respondents

Openness subscale: Cronbach's $\alpha = .80$, based on 416 respondents

(v) Actively Open Minded Thinking Scale (Stanovich & West, 1998):

Cronbach's $\alpha = .45$, based on 413 respondents.

(II) Preliminary Correlational Results

Preliminary analyses reveal that, as expected, many of the individual difference measures are correlated with the decision-making variables, including accuracy and reaction time.

For example, the Need for Cognition was associated with accuracy on the vocabulary task and the knowledge task, such that individuals high in Need for Cognition were more likely to do well on the vocabulary task, $r\ (102) = .23$, $p = .022$, and on the knowledge task, $r\ (102) = .24$, $p = .013$. As another example, Personal Fear of Invalidity was associated with reaction time for the knowledge task, such that high scores on the Personal Fear of Invalidity measure were associated with longer reaction times, $r\ (102) = .25$, $p = .01$.

These preliminary results are encouraging and suggest a continued effort directed toward analyzing the data is warranted.

Summary

In accordance with the statement of work for this contract, the data collection for the project was successfully completed. Over one hundred participants completed the individual

difference measures and the decision making tasks. The reliability analyses reveal that, with the exception of the Actively Open-Minded Thinking scale, the reliabilities associated with each of the individual difference measures were adequate (i.e., moderate to high reliabilities).

Preliminary data analyses completed thus far, indicate that many of the individual difference measures assessed are correlated with participants' performance (i.e., speed, accuracy), confidence (i.e., subjective confidence rating, reaction time for confidence rating), and judgment (i.e., calibration, resolution).

Future Directions.

This project represents an initial investigation of the individual difference variables that are associated with judgment and decision-making. This research has theoretical and practical value. Theoretically, this type of research will demonstrate the predictive validity of individual difference variables that are hypothesized to be related to cognitive function. This research has practical value within a military context, because knowledge of the individual difference variables that are related to performance in decision-making can be used for personnel selection, and can highlight the conditions that might be most problematic for certain individuals and so should be particularly stressed during training.

Detailing areas of future research is a challenge because only very preliminary results of the present study are available. Nonetheless, one particularly intriguing area of future research may well involve the assessment of the manner in which individual difference variables and the restriction of cognitive capacity interact to affect judgment and decision-making. Often, military personnel are required to make decisions under conditions of restricted cognitive capacity (e.g., fatigue, time constraints). Thus, the relationships that we find between individual difference variables and decision-making may be exacerbated under conditions in which there is a restriction of cognitive capacity. For example, Petty (1999) demonstrated

that individuals who are high in need for cognition are more likely to be influenced by subtle situational information than are their low need for cognition counterparts. Moreover, a large body of research has demonstrated that under conditions in which cognitive capacity is restricted, individuals are likely to be influenced by subtle changes in the environment (e.g., MacDonald, Zanna, & Fong, 1995; MacDonald, Fong, Zanna, & Martineau, in press; Steele & Josephs, 1990). Thus, we speculate that when individuals are under conditions of restricted cognitive capacity, induced by factors such as time pressure and/or fatigue, they may be more highly influenced by situational information than those who are not under conditions of restricted cognitive capacity. In addition, individual difference variables may interact with restriction of cognitive capacity, such that certain types of individuals (e.g., those who are high in need for cognition, high need for structure) will show a marked susceptibility to changes in decision-making under restrictions of cognitive capacity.

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Appendix A

Consent form

I, _____, age _____ hereby state that I have volunteered for a study assessing factors that affect decision-making.

I understand that participation in this study will involve completing a series of decision-making tasks on the computer, which will take approximately 2 hours to complete.

I understand that I will receive $20.00 for participating in this study.

I hereby authorize the use of all records, tests and personal data derived from this experiment for research purposes providing that there is no disclosure of the identity of the undersigned.

By signing below, I indicate that I understand the nature of this study, and consent to participate voluntarily as a subject. I understand that I am free to discontinue participation of this study at any time, and that I am in no way obliged to participate.

Please print your name: _____

Your signature: _____

Dated: _____

This study has been approved by Research Services, whose purpose is to review research conducted at the University of Lethbridge.

Consent form (Session 2)

I, _____, age _____ hereby state that I have volunteered for a study assessing factors that affect decision-making.

I understand that participation in this study will involve completing a decision-making task on the computer, which will take approximately 1 hour to complete.

I understand that I will receive $10.00 for participating in this study. Moreover, because I have participated in both sessions of this study, my name will be entered into a draw for a $50.00 gift certificate from the University of Lethbridge bookstore.

I hereby authorize the use of all records, tests and personal data derived from this experiment for research purposes providing that there is no disclosure of the identity of the undersigned.

By signing below, I indicate that I understand the nature of this study, and consent to participate voluntarily as a subject. I understand that I am free to discontinue participation of this study at any time, and that I am in no way obliged to participate.

Please print your name: _____

Your signature: _____

Dated: _____

This study has been approved by Research Services, whose purpose is to review research conducted at the University of Lethbridge.

Appendix B: Summary of Sample Demographic Variables

	Scale	N	Minimum	Maximum	Mean/ Total Score	Std. Dev.
COGNITIVE STYLE MEASURES	Personal Need for Structure	419	1.64	5.32	3.23	0.50
	Personal Fear of Invalidity	416	2.00	190.0	126.5	20.61
	Need for Cognition	418	2.50	9.00	5.86	1.03
'Big Five' FACTORS OF PERSONALITY	Extraversion	418	1.25	5.00	3.37	0.83
	Agreeableness	418	1.89	8.33	3.85	0.63
	Conscientiousness	418	1.56	4.89	3.57	0.60
	Neuroticism	418	1.00	4.75	2.91	0.76
	Openness	418	1.67	5.00	3.77	0.64

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14 ABSTRACT

(U) Abstract

This report outlines the methodology and presents selected findings from a study that was designed to investigate how individual difference variables in decision-making influence judgment processes. Specifically, we assessed the extent to which three individual difference variables (Personal Need for Structure, Personal Fear of Invalidity, Need for Cognition) influenced speed, accuracy, and confidence in a number of decision-making tasks under varying degrees of uncertainty. One hundred and four participants (30 men and 74 women) were recruited from the University of Lethbridge. The participants completed a battery of questionnaires including the individual difference variables under consideration. Students were contacted and were invited to participate in two experimental sessions. In one session, they completed a series of computer-administered decision tasks (e.g., line length estimation, vocabulary, and trivia knowledge). In another session, the participants completed a military threat assessment task called TITANS (Team and Individual Tactical Assessment Networked Simulator), a medium fidelity computer-based naval surveillance and threat assessment task. Preliminary results reveal associations between the individual difference variables and speed, confidence, and accuracy in decision-making. Future directions for research with respect to the interaction of individual differences in decision making and restriction of cognitive capacity (e.g., due to fatigue and/or time pressure) are discussed.

Le présent rapport décrit la méthodologie et expose certaines des constatations d'une étude conçue pour examiner la façon dont les différences individuelles dans la prise de décision influent sur les processus de jugement. Plus particulièrement, nous avons évalué dans quel mesure trois variables de différences individuelles (besoin personnel de structure, crainte personnelle d'incapacité et besoin de cognition) agissaient sur la vitesse, l'exactitude et la confiance dans l'accomplissement d'un certain nombre de tâches décisionnelles, à divers degrés d'incertitude. Au total, 104 participants (30 hommes et 74 femmes) ont été recrutés à l'Université de Lethbridge. Les participants ont rempli un éventail de questionnaires portant notamment sur les variables de différences individuelles susmentionnées. Les étudiants ont été invités à participer à deux séances expérimentales. Au cours de l'une des séances, ils ont accompli une série de tâches décisionnelles à l'ordinateur (estimation de longueur de ligne, vocabulaire et connaissances générales). Dans le cadre de l'autre séance, les participants ont effectué une évaluation de menace militaire intitulée TITAN (Réseau d'évaluation des menaces pour l'individu ou le groupe). Il s'agit d'une simulation informatisée de surveillance navale et d'évaluation des menaces, qui est de fidélité moyenne. Les résultats préliminaires ont révélé des corrélations entre les variables de différences individuelles et la vitesse, la confiance et l'exactitude dans la prise de décision. On y discute aussi l'orientation future des recherches concernant l'interaction de différences individuelles dans la prise de décision et la restriction de la capacité cognitive (fatigue et/ou contrainte de temps).

15 KEYWORDS, DESCRIPTORS or IDENTIFIERS

(U) decision making, individual differences

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